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TECHNICAL REPORT NO. 74-82

BALLOON MARKER

by

Benjamin F. Wood

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ABERDEEN PROVING GROUND, MD.

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June 1974

Final Report

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U. S. ARMY LAND WARFARE LABORATORY

Aberdeen Proving Ground, Maryland 21005

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A tethered balloon position marker was developed for use by troops operating in heavy forests. The system consists of a ten cubic-foot aerodynamically shaped balloon, two solid chemical hydrogen generator inflation cartridges, a strobe light for night time use, a tether line, and a carrying case. The system is an improved version of a system developed earlier which used a spherical balloon and a cylinder of compressed helium for inflation. The		
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improved balloon shape provides better vertical flying qualities, and the hydrogen generator reduces weight. A battery with improved shelf life is used in the strobe light. An evaluation quantity of the marker systems was furnished to user units for evaluation; the results were not available for inclusion in this report.

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PREFACE

This task was conducted by the Mobility Branch of the US Army Land Warfare Laboratory. The strobe lights were procured by specification from the Electronics Division of The Chromalloy Corporation. The balloon configuration was adapted from a G. T. Schjeldahl Co. design, and the balloons were fabricated by the Defense General Supply Center, Richmond, VA. The hydrogen generators were developed and furnished by the Naval Ordnance Station, Indian Head, MD.

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INTRODUCTION

Problem

Troops operating in heavily forested areas require a position marker visible from support aircraft. Smoke signals deployed at ground level either drift and diffuse before they rise above the forest canopy, or they lie near ground level. Smoke or flare rounds fired above the canopy provide only a brief marking of the position, which may not be long enough to orient on, or which may not be seen at all from the aircraft.

Airborne units also have a site marking problem. A persistent elevated site marker is required as an assembly point for troops scattered over a wide area in an airdrop zone.

Background

A helium filled spherical balloon marker system was developed at the request of the 5th Special Forces Group. This system provided an adequate marker so long as the winds did not exceed 10 miles per hour. Above this velocity, the balloon was blown down into the tree tops where it was less visible, or not visible at all from some sighting angles. Sometimes it was punctured by contact with the tree branches. The helium-filled pressure vessel resulted in a system weight which was excessive; and, as it later developed, the bottle was hazardous. The development of this system has been reported, along with an analysis and discussion of the detection aspects of position markers in general.¹

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¹Improved Elevated Site Marker, Final Report No. 74-07 (AD775463), USA Land Warfare Laboratory, December 1973.

DESCRIPTION

The Balloon Marker consists of the following components which are shown in Figure 1.

Balloon

The balloon is a modified teardrop shape with tandem airscoops at the tail end as shown in Figure 2. The capacity is ten cubic feet. The balloon is fabricated from 1/2 mil polyimide film coated on one side with aluminum and a fluorescent green or orange pigment. The film weight does not exceed 2.5 grams per square foot. The butt-seam construction is joined with 1-inch wide polyimide pressure sensitive tape (3M Co. No. 92). The silicone adhesive is oven cured after fabrication for 4 hours at 325°F. See Reference 1 for discussion of sighting probability and visibility range.

Fill Tube

A ten-foot long 4-inch diameter fill tube is furnished to provide for pre-cooling of the hydrogen. The material and construction is the same as for the balloon. The fill tube is pre-assembled with the balloon and with an adaptor at its other end for attachment to the hydrogen generator.

Hydrogen Generators

Two hydrogen generators are required, each generating slightly over five cubic feet of hydrogen. The generators are cylindrical, 1.85 inches diameter and 7.5 inches long, and weigh 8 ounces each. The generators are ignited by an electrically actuated primer. The generators are not refillable and are discarded after use.

Strobe Light

The strobe light uses an Xenon tube and a lithium battery. The flash rate is one per second for 30 minutes without decrease in either rate or intensity. The weight is 2.15 ounces. See Reference 1 for discussion of sighting probability and visibility range.

Tether Line

The 20 pound test nylon monofilament tether line is 300 feet long, and weighs 0.75 ounces.

Miscellaneous

A 1.5 volt AA-cell battery is provided to ignite the generator primer. A single-edge razor blade is provided to cut the fill tube from the balloon. The carrying case includes a paper wadding material which protects the contents from handling damage, and is also used as a hot pad for removing the first expended gas generator. An instruction sheet is included.

The total system weight is 2.0 pounds.



Figure 1. Balloon Marker Components



Figure 2. Balloon Marker

Operation

The balloon is inflated by connecting the fill tube adaptor to one of the hydrogen generators by means of the threaded connection. The generator is actuated by placing the wire leads across the battery. The generator produces its gas in approximately 90 seconds. The first generator is disconnected, using the hot pad furnished to hold the hot generator casing. After the second generator has been attached and expended, the fill tube is rolled up or milked until the balloon is filled taut. This procedure allows the gas in the balloon time to cool, and insures that the balloon is fully filled so that it will fly properly in the wind. Usually there is an excess of gas. In this case the fill tube is squeezed shut by hand and pulled loose from the generator. Then the fill tube is rolled up as above, and when the balloon is taut the fill tube is cut with the razor blade, allowing sufficient length to tie a knot to prevent escape of the gas. For night use the strobe light is attached to the tether approximately 20 feet below the balloon.

DEVELOPMENT AND TESTS

Balloon

Various balloon configurations were considered and tested to satisfy the goal of flying in a 30 miles per hour wind at an angle from the vertical not exceeding 45°. A spherical-conical teardrop design was fabricated and tested. Limited test data indicated it had good flying qualities, but a simpler two-gore configuration with acceptable flying qualities was chosen because it cost less to fabricate.

The Polymide film and tape were chosen to withstand the hydrogen gas temperatures and to satisfy the requirements for low weight and resistance to pinholes from folding and handling. The aluminum coating provided an opaque base for color density. The self-luminous colors provided maximum visibility.

Inflation and flight tests verified that the balloon materials, construction, and flying qualities met the requirements. The balloons remain inflated without substantial loss of gas for a minimum of two hours. Generally the balloons will remain aloft for twelve hours or more.

Hydrogen Generators

The development of the hydrogen generator is reported elsewhere.² Since the generators were available without further development only in the five cubic foot capacity, two generators were used to produce the required ten cubic feet of gas. The two hydrogen generators are only approximately half the weight of the one helium bottle used in the original system. Also the hazard of the high pressure bottle rupturing from bullets or shell fragments is eliminated. The quantity of hydrogen gas involved is not considered hazardous in the open air.

The generators produced gas of sufficient purity and in the required volume to provide the necessary lift.

A separate development was conducted to provide a lower cost ten cubic capacity gas generator. A separate report of this unsuccessful development was published.³

²Barber, Bercket and Dingle, Naval Ordnance Station, Indianhead, MD. Solid State Hydrogen Generator, Paper No. 73-1232 Presented at AIAA/SAE, 9th Propulsion Conference, Las Vegas, NV, November 5, 1973.

³Development of a Site-Marker Balloon Inflation System, Final Report No. LWL-CR-03M73, MSA Research Corporation, June 1974.

Strobe Light

The strobe lights are the same lights developed for the earlier system (Reference 1), except that a quantity of lights on hand was refurbished by replacing the alkaline batteries with lithium batteries. This was done to obtain a longer shelf-life than the two years of the alkaline batteries. The actual shelf-life of the lithium batteries has not yet been determined, but accelerated tests by the manufacturer have predicted 10 years.

A quantity of balloon systems has been provided for evaluation by the US Marine Corps, Quantico; and the 82d Airborne Division, Fort Bragg. The results of these evaluations were not available for inclusion in this report. Also, a few sample items were furnished to the US Army Natick Laboratories which will have the continuing responsibility for this item.

CONCLUSIONS

The Balloon Marker is effective in providing a persistent night or day elevated position marker for use by troops operating in heavily forested areas, or by airborne units as assembly point after an airdrop.

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